FOREST ANALYSIS BRANCH

# Expedited timber supply review for the Lakes, Prince George and Quesnel timber supply areas

## Public Discussion Paper

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# Public Discussion Paper

## Foreword

**by Larry Pedersen, Provincial Chief Forester**

During this summer 2004, as provincial chief forester I will complete my review of the timber supply and if necessary re-determine allowable annual cuts for three severely beetle-infested areas: the Lakes, Prince George and Quesnel timber supply areas.

Mountain pine beetle* *(see definition on next page)* epidemics are natural events, however the current infestation has reached an unrecorded level in B.C.'s history. The epidemic beetle population and our harvesting response to it, will inevitably affect the structure of the forests in the infested areas. While the damage and loss of timber will have obvious economic effects for many decades, the changes to the forest will also have ecological impacts. As the structure and age of the forest change over time, a variety of important ecological functions such as wildlife habitats or hydrological regimes will change as well.

Over the last few months, staff have been examining conservation values, the timber supply, management practices, options and implications of increasing the harvest levels to recover economic values in the wake of the infestation in the three timber supply areas.

Based on my review of the mounting information about the epidemic and its potential impact on timber supply and forest habitats[1], I believe there are compelling reasons to review the timber supply and harvest levels in the three severely infested areas. Prior to completing my review and determining new allowable annual cuts, I believe it is important to publicly report on the information gathered thus far.

In fall 2003, I reported that without very cold winter weather, in about three years the infestation could affect up to 50 percent of the lodgepole pine forests in B.C.'s central interior. Furthermore based on this, in about 15 years after the beetle-killed trees are no longer projected to be economically usable, about 200 million cubic metres could be beetle-killed and remain unsalvaged. To be clear, this amount of unsalvaged wood was projected to remain after a significant amount of harvesting occurred during this period. Of the 200 million cubic metres (mature pine), about 60 percent was estimated to be within the three timber supply areas examined in this report.

Subsequent to the release of 2003 information, ongoing research studies[2] have confirmed earlier projections that around the time of the 2006 beetle flight, about 50 percent of the pine volume in B.C.'s interior will have been infested. However, in addition to confirming the earlier projections, the experts also warn that it is increasingly likely that the infestation will continue unabated beyond the next several years and it is entirely possible that far greater than 50 percent of the mature pine volume will be infested. The results of the ongoing studies show that 80 percent of the lodgepole pine volume in BC's interior could be infested by 2013.

It is difficult to predict with certainty when the outbreak will subside and following this how much live pine will remain. However, with each passing year, Forest Service staff, federal researchers and the forest industry are able to update the projections and improve the estimates of affected area and beetle-killed volume. After the mountain pine beetle flight in 2002 (reported as red-attack in the fall of 2003) in the three timber supply areas, the cumulative unharvested beetle-killed volume was estimated to be about 80 million cubic metres. Staff estimate that at current harvest levels, about 40 million cubic metres could remain unharvested (see further details below, under *Assessment of the mountain pine beetle epidemic*). Also after this summer's beetle flight, staff estimate that the amount of beetle-killed volume could be about 160 million cubic metres in the three timber supply areas. Based on the available data and research, whether harvest levels are increased or not, the current mountain pine beetle epidemic will have a significant impact on timber supplies, the environment and the communities that depend on the surrounding forests. It is for this reason that I have asked for significant additional analysis on the state of the infestation and the options and implications associated with increasing the harvest levels in the three timber supply areas.

(1) Timber Supply and the Mountain Pine Beetle Infestation in British Columbia. MoF. October 2003

(2) Provincial Level Projection of the Current Mountain Pine Beetle Outbreak, MoF & CFS (unpublished). May 2004

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The rapid expansion of the outbreak in B.C.'s central interior in the last three years has been unprecedented and has surpassed previous projections. In some of the hardest hit areas in the Lakes, Prince George and the Quesnel timber supply areas, most of the suppression activities are no longer considered to be effective. I recognize that suppression harvests are still occurring in green-attacked trees in some areas. However, now in post-suppression management (no longer stopping the spread) in many areas within the three timber supply areas, forest managers are examining ways to redirect and focus harvesting in sites that reflect their highest value, including leaving areas for non-timber values.

In determining whether to increase harvest levels to salvage more beetle-killed trees, my considerations and ultimate determination will have to carefully consider the risk and uncertainty associated with the ongoing growth in the infestation along with its inherent future timber supply implications. As well, my decision must consider any further risks introduced by increasing harvest levels at this time instead of waiting until the following years.

It will not be possible or desirable to harvest all of the beetle-killed trees, however increased activities will ensure that harvested areas are promptly reforested as well as provide opportunities to recover some value from the dead trees. The province has publicly asked for expressions of interest to seek input on ways to utilize and market the dead trees. It is timely for my review of the projected mortality and attendant timber supply implications to be coordinated with this work in order for the province to determine what additional economic opportunities might be supportable in the near future.

It is important that the public have an opportunity to review the information that I will be considering and to provide input regarding my upcoming review of allowable annual cuts in the three timber supply areas.

Larry Pedersen, Chief Forester

**Mountain pine beetles* (MPB), *Dendroctonus ponderosae Hopkins (Coleoptera: Scolytidae), are the most damaging insect that attacks lodgepole pine in western Canada. The insect is a bark beetle, a small, cylindrical insect that attacks and kills mature trees by boring through the bark and mining the phloem—the layer between the bark and wood of a tree.*

*The beetles also carry a fungus (with a blue stain) that causes dehydration and inhibits a tree's natural defenses against beetle attacks.*

# Expedited timber supply reviews in the Lakes, Prince George and Quesnel TSAs

The British Columbia Forest Service has completed an assessment of the timber supply* that has been attacked, or at risk of attack by mountain pine beetles in the Lakes, Prince George and Quesnel TSAs. The findings are summarized in this discussion paper. This discussion paper is intended to provide British Columbians with an overview of the timber supply review process and harvest level forecasts for the Lakes, Prince George and Quesnel TSAs, and to encourage them to provide comments during a 30-day public review period. **Public comments will be accepted until 4:30 p.m. on July 9, 2004.**

In accordance with the *Forest Act*, Section 8—and under normal circumstances—the chief forester reviews and determines new allowable annual cuts (AACs*) for each of the 37 TSAs* and 34 tree farm licences (TFLs*) in the province at least once every five years. In a few cases where the chief forester determines that the allowable annual cut would not likely change significantly, then the next harvest level decision may be postponed by up to five more years.

The total AAC for the three TSAs is currently set at 18.4 million cubic metres a year. The AAC already includes an increase of 5.5 million cubic metres (since 2001/2002) for the management of the mountain pine beetle infestation. On average for the three TSAs, lodgepole pine comprises about 60 to 65 percent of the total trees harvested. This percentage will likely continue to increase in the short term as more harvesting is directed towards pine. Up to now, the majority of the increased harvesting has been aimed at reducing the spread of the infestation in pine forests. However even with the increased harvest operations, the infestation has continued to spread. At current harvest levels, staff estimate that after this summer's beetle flight, the amount of beetle-killed timber could be as much as 160 million cubic metres and a significant amount of dead timber will remain unsalvaged. Therefore, the chief forester will consider if it is necessary to increase harvest levels to reflect the need to promptly reforest infested areas and to salvage more beetle-affected stands before they deteriorate.

The chief forester's determination is an independent, professional judgment based on the best available information. By law, the chief forester is independent of the political process, and is not directed by the minister of forests when determining AACs.

Before setting new AACs, the chief forester will review all relevant reports and public input. The chief forester's determination will be outlined in a rationale statement, which along with the summary of public input, will be available to the public upon release. Following the release of the AAC determinations by the chief forester, the minister of forests will apportion the AAC to the various licences and programs.

*See last section below for details about submitting written comments.*

**Throughout this document, an asterisk after a word or phrase indicates that it is defined in a box at the foot of the page.*

**Timber supply is the quantity of timber available for harvest over time. Timber supply is dynamic, not only because trees naturally grow and die, but also because conditions that affect tree growth, and the social and economic factors that affect the availability of trees for harvest, change through time. For a timber supply area (TSA)*, the timber supply analysis forms part of the information used by B.C.'s chief forester in determining *AACs — the permissible harvest level for the area.*

**TSAs — integrated resource management units established in accordance with Section 7 of the Forest Act.*
**TFLs — provide rights to harvest timber, and outlines responsibilities for forest management, in a particular area.*

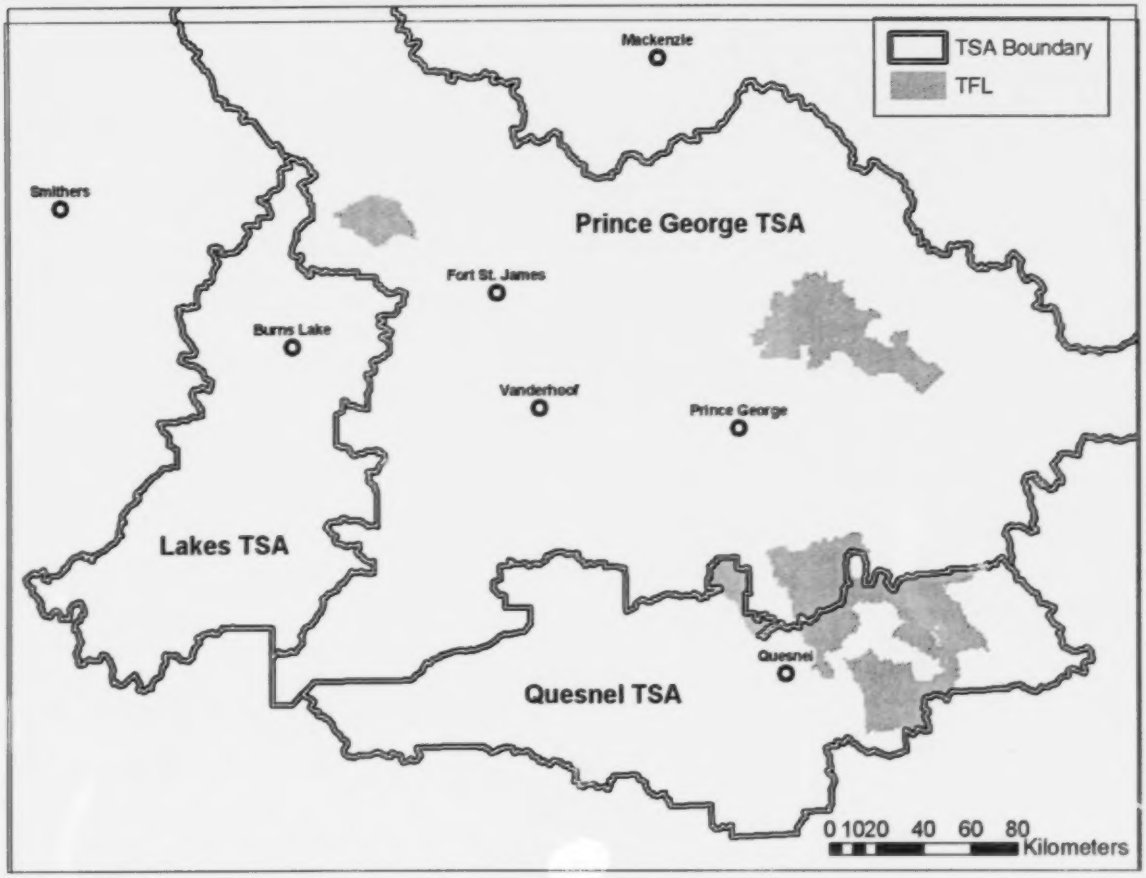


Figure 1. Map of the Lakes, Prince George and Quesnel timber supply areas

## Description of the three timber supply areas

The Lakes TSA extends from Babine Lake in the north to the Entiako River in the south and lies along the northeastern boundary of Tweedsmuir Park. It is administered by the Nadina Forest District office located in Burns Lake. The timber supply area covers about 1.12 million hectares, of which about 590,000 hectares are considered available for forest management and harvesting under current management practices—the timber harvesting land base.

The Prince George TSA is comprised of the Fort St. James, Prince George and Vanderhoof districts. The timber supply area covers about 7.5 million hectares, of which 3.4 million hectares are considered available for timber harvesting under current forest management practices. In terms of AAC, it is the largest management unit in the province.

The Quesnel TSA extends from the Itcha Ilgatchuz Mountains in the west to Bowron Lake Provincial Park in the east. It is administered by the Quesnel Forest District office located in Quesnel. The total timber supply area covers about 1.6 million hectares, of which about 1.0 million hectares is considered available for timber harvesting under current management practices.

## Current allowable annual cuts

In July 2001, the chief forester set the allowable annual cut (AAC) for the Quesnel TSA at 3,248,000 cubic metres, reflecting an increase of about 1.0 million cubic metres for the management of the mountain pine beetle infestation.

In August 2001, the chief forester set the AAC for the Lakes TSA at 2,962,000 cubic metres, reflecting an increase of about 1.5 million cubic metres for the management of the mountain pine beetle infestation.

In June 2002, the chief forester set the AAC for the Prince George TSA at 12,244,000 cubic metres, reflecting an increase of about 3.0 million cubic metres for the management of the mountain pine beetle infestation.

## Land use and resource planning

### Lakes TSA

In 2000, the Lakes Land and Resource Management Plan (LRMP) was approved and provides important direction for the management of public forest lands in the Lakes TSA and North Tweedsmuir Provincial Park. Since then, the Lakes LRMP has provided direction for two designated higher level plans (HLPs), which are primarily regarding landscape and stand-level biodiversity.

During the course of the current mountain pine beetle outbreak, variances from the higher level plans have been developed. To achieve specific forest management and conservation objectives, the local regional manager of the Ministry of Water, Land and Air Protection and the district manager of the Nadina Forest District have agreed to a temporary deviation from early seral stage requirements including some specific caribou management zones. This agreement is consistent with the higher level plan and is in effect for five years from February 21, 2003.

### Prince George TSA

There are three LRMP processes that cover the Prince George TSA. The Vanderhoof, Fort St. James and Prince George LRMPs were approved in the late 1990's. Each LRMP provides important direction for the management of public forest lands in the Prince George TSA.

A small portion of the Cariboo Chilcotin Land Use Plan extends into the southern part of the Prince George and Vanderhoof Forest Districts. Within these areas, the Nuxalk-Carrier Grease Trail (Alexander Mackenzie Route) has a management plan under the Cariboo Chilcotin Land Use Plan. The current MPB infestation has, by and large, not caused requests for variances in these plans except for some known scenic areas in the Vanderhoof LRMP and along the Grease Trail corridor.

The LRMPs will soon undergo a review in accordance with the MPB action plan (discussed below). Scenic values, biodiversity, access management and wildlife habitat are some of the aspects that will be considered.

Draft old-growth management objectives for the Prince George TSA are currently in the public review phase. These objectives have taken into account the current beetle infestation and call for a certain level of retention of beetle-killed forest.

### Quesnel TSA

The Quesnel TSA is within the area covered by the 1994 Cariboo Chilcotin Land Use Plan (CCLUP). The CCLUP outlines objectives and targets for timber and non-timber values. Following the completion of the plan, the *Cariboo-Chilcotin Land-Use Plan Integration Report* and other detailed implementation strategies for biodiversity, mule deer and caribou habitat guide current forest management plans and activities. Forest development is required to be consistent with aspects of the plan that have HLP designation, as authorized by the *Forest Practices Code* and the *Forest and Range Practices Act*.

Any additional or accelerated harvesting to salvage timber from infested stands or to control further spread of mountain pine beetle continues to be undertaken consistent with the objectives of the HLP. To the extent possible, this has been addressed by shifting harvesting to heavily infested or damaged stands and away from stands that can continue to contribute to achieving the HLP targets (see section below, under *Proposed strategies* for managing the epidemic).

The Cariboo Interagency Management Committee and the Cariboo Chilcotin Regional Resource Committee are mandated by government to monitor the implementation of the CCLUP. The BC Forest Service continues to keep these groups informed of the beetle control and timber salvage measures, and will request their advice or direction where required to manage any risk to achievement of the CCLUP targets.

## Forest stewardship

This section is the summary from *Forest Stewardship in the Context of Large-Scale Salvage Operations: An Interpretation Paper*, which is attached as Appendix A.

All indications are that the current mountain pine beetle outbreak will have a significant impact on a large proportion of the pine forests in BC (Eng *et al.* 2004). It is neither desirable nor possible to harvest all of the impacted pine forests. However, any further increases beyond current harvest levels must carefully consider all forest values. This section provides recommendations to the chief forester about methods to conserve forest values, to the extent possible, while mitigating timber losses.

Poorly planned and/or poorly executed large-scale salvage operations have the potential to cause significant negative effects on a variety of forest values (Lindenmayer *et al.* 2004):

- salvage harvesting activities can undermine many of the ecosystem benefits of major disturbances;
- removal of large quantities of biological legacies* can have negative impacts on taxa that require, or benefit from, those legacies;
- salvage logging can impair ecosystem recovery; and
- some taxa may be maladapted to the interactive effects of two disturbance events in rapid succession.

There are additional, specific and significant concerns about the potential for large-scale salvage operations to affect hydrological regimes at various scales (Foster *et al.* 1997).

Some contend that the magnitude of the current outbreak is at least partially the result of human influence on the pine forests in BC, principally due to forest fire suppression (Stadt 2002, Taylor and Carroll 2003). If that is the case, it could be argued that it is incumbent on forest managers to attempt to mitigate the effects of the outbreak through appropriate management that includes well-planned and properly executed large-scale salvage operations. By diverting harvest from green to dead trees, the impact on forest values could be partially mitigated.

Others contend that the outbreak is a 'natural' event (Hughes and Drever 2001). If that is the case then the large areas of partially dead forests created by the outbreak are within the 'range of natural variability' (Swanson *et al.* 1994, Wong and Iverson 2004). Regardless of the cause, large-scale salvage operations will result in conditions that differ from those that would be created by the outbreak alone and the combined effects will be outside the range of natural variability. In any case it is clear that society does not support managing for the entire range of natural variability, for example 1,000-year floods, meteor strikes, etc. At the same time some management response to the outbreak is appropriate and likely requires a large-scale response.

The following is a summary of the key recommendations regarding forest stewardship. These recommendations are intended to inform the determination of the allowable annual cuts for the Lakes, Prince George and Quesnel timber supply areas:

- At the landscape level (10,000 to 100,000 hectares) at the very least, leave what was originally planned under existing landscape level plans (regional land use plans, land and resource management plans, etc). This includes provisions for old-growth management areas since areas with considerable dead pine are still of value to biodiversity and should be retained if no suitable replacement old-growth areas are available. Mixed species stands should be used wherever possible to contribute to the mature requirement; however, stands with some dead pine still provide biodiversity values.

**Legacies are unharvested areas or coarse woody debris that are likely to persist on the landscape for at least 80 to 100 years.*

- As a general rule, there should be little, to no salvage harvesting in the non–contributing land base (areas outside of the timber harvesting land base as assumed in the last timber supply analysis for the three TSAs).
- There should be no changes to the provisions made for riparian management areas (RMAs) and riparian reserve zones (RRZs). It will likely be desirable to remove some of the dead pine component from RMAs rather than other species if they occur. It will be important to carefully monitor the management of RMAs and RRZs over time because of the potential for excessive inputs of large woody debris into streams and the potential for increases in peak flow regimes may cause increased erosion and transportation of sediment and woody debris. As well, there should be no changes to the management of wildlife tree patches, wildlife habitat areas and other fine filter measures.
- Legacies of coarse woody debris should be left throughout the blocks. Higher levels of retention than those recommended under the *Forest and Range Practices Act* for harvesting in healthy forests will be appropriate because, under natural conditions, most beetle-killed stands would have very high levels of coarse woody debris.
- The creation of large openings (> 1,000 hectares) will be appropriate, provided that they are designed to respect existing land use planning objectives. In addition the legacies of unharvested areas within the openings should increase in proportion to the increasing size of the opening (up to 25% in the case of 1,000 hectare openings).
- The spatial distribution of legacies, including wildlife tree patches can be as important as the relative amounts remaining. Clearly wind firmness will become a significant issue but the legacies of live and dead trees that will be left will be valuable whether or not standing. It is important to ensure the legacies are representative of the "matrix" forests, for example reserve wet spruce or aspen forests if not able to maintain any mature pine forests.

Other related recommendations include:

- A large number of temporary access structures (roads, trails, landings, etc.) will be created over a very short period of time. Development of those structures should adhere to all existing regulations and they should be decommissioned as soon as possible after operations have ceased. Increased access resulting from improvements to permanent roads must be carefully managed to prevent negative effects on wildlife populations.
- To reduce adverse effects on peak flows and soil erosion, no harvesting should occur on unstable terrain, harvested area should be promptly and fully restocked, and all potentially 'compromising' access structures should be rehabilitated.
- Where ecologically acceptable, plant species other than pine to lessen future problems with mountain pine beetle outbreaks.
- Conducting salvage operations based on the premise of reducing fire risk is not recommended except in the wildland-urban interface.
- Monitoring programs should recognize the requirement for implementation monitoring (did we do what we said we were going to do?) and effectiveness monitoring (did our actions have the desired effect?). A well-planned monitoring program must be developed to include both of these aspects.

## First Nations

### Lakes TSA

Six First Nations (Burns Lake, Cheslatta , Nee-Tahi-Buhn, Skin Tyee, Wet'suwet'en, and Lake Babine [Natoot'en]) with resident communities are located in the Lakes TSA. Other First Nations (5) with asserted traditional territories which extend into the Lakes TSA include Nadleh Whut'en, Stellat'en First Nation, Tl'azt'en First Nation, Yekooche First Nation and Ulkatcho.

### Prince George TSA

Fourteen First Nations groups comprise about six percent of the Prince George TSA population. Nine First Nations have communities within the TSA which include Nak'azdli, Takla Lake, Tl'azt'en, Nadleh Whut'en, Stellat'en, Saik'uz, Lheidli T'enneh, McLeod Lake, and, Yekooche First Nations. In addition, eleven First Nations; Cheslatta, Lhoosk'uz Dene, Ulkatcho, Gitxsan, Lake Babine (Natoot'en), Kaska Dena, Tsay Keh Dene, Red Bluff, Ndazkhot'en (Nazko) and Tahltan have asserted traditional territories within the Prince George TSA.

### Quesnel TSA

Four First Nations (Alexandria Band, Lhoosk'uz Dene, [Kluskus], Red Bluff Band, and Ndazkhot'en [Nazko] Band) have resident communities in the Quesnel TSA. Saik'uz First Nation, Ulkatcho Band, T'exelc (Williams Lake), Xats'ull (Soda Creek), Lheidli-T'enneh Band, Tsi Del Del (Alexis Creek) and Tl'etinqox (Anahim) are neighbouring communities with asserted traditional territories.

In summary, during past timber supply reviews many of the First Nations have expressed concerns about timber harvesting in areas with high cultural, environmental and economic values. Cultural and environmental considerations, where information has been provided, have been taken into account in defining the area suitable for timber harvesting, and in developing and applying forest cover requirements in the timber supply analysis.

Allocations of the economic opportunities that may arise from the AAC decisions are not part of the timber supply review process, but remain the responsibility of the Minister of Forests. Any decisions on treaty negotiations with the First Nations that have been undertaken by government have also been accounted for in the reviews. The timber supply review and AAC determination should not be considered as limiting the Crown's legal obligations resulting from recent court decisions.

## Assessment of the mountain pine beetle epidemic

Mountain pine beetle infestations are natural events in BC. The last major infestation was in the Chilcotin during the 1980s and covered approximately 400,000 hectares. Beetle-killed trees were harvested as merchantable sawlogs and pulp (chip) fibre for many years after the infestation was halted by cold winter weather.

The current outbreak is believed to have started around 1994. While it increased steadily for a number of years, it has only been in the last two to three years that the outbreak has rapidly expanded. By 2002, the outbreak had exceeded all previous records and continues to grow at epidemic levels in the three TSAs. Many of the mature (older than 80 years), and now some immature (60 years old) lodgepole pine stands have been infested by the mountain pine beetle.

The following table reflects the projected cumulative volumes estimated to be killed by the beetle over the next six years. The table only provides the estimate of beetle-killed timber, and does not include non-infested trees that will likely be harvested to salvage the beetle-killed timber. The timber supply analysis (see below, under *Timber supply forecasts*) reflects the estimated volume killed as reported for 2005 (this summer's beetle flight) in Table 1.

Table 1. Projected cumulative volume and percent volume killed of beetle-killed pine[a] on the timber harvesting land base

| | Includes up to the previous summer's flight[b] | | | | | |
|---|---|---|---|---|---|---|
| **TSAs** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** |
| | **Cumulative volume — millions of cubic metres** | | | | | |
| Lakes | 25 | 30 | 34 | 38 | 42 | 46 |
| Prince George & by district: | 79 | 100 | 127 | 141 | 158 | 171 |
| Ft St James | 17 | 24 | 32 | 39 | 45 | 50 |
| Prince George | 22 | 27 | 38 | 38 | 43 | 47 |
| Vanderhoof | 40 | 49 | 57 | 64 | 70 | 74 |
| Quesnel | 56 | 66 | 73 | 79 | 83 | 87 |
| Total volume | 160 | 196 | 234 | 258 | 283 | 304 |
| | **Percent of pine volume killed** | | | | | |
| Percent volume killed | 34% | 42% | 49% | 55% | 60% | 64% |

Source: Derived from the Provincial Level Projection of the Current Mountain Pine Beetle Outbreak, MoF & CFS (unpublished), May 2004.

(a) Lodgepole pine trees older than 60 years and greater than 12.5 centimeters diameter at breast height.

(b) The volume is reported in the year the trees turn red, which is usually the year after the beetle flight and attack.

Staff estimate that after the beetle flight in 2002, the cumulative unharvested beetle-killed volume in the three TSAs was about 80 million cubic metres. Of this volume, given the current harvest levels, about 40 million cubic metres could remain unharvested. As reflected in Table 1, the 2003 beetle flight and the anticipated 2004 flight could increase the beetle-killed volume to 160 million cubic metres, or about 34 percent of the pine volume over 60 years old.

The infestation is expected to continue to spread beyond this year. There is no indication the spread of the infestation will slow significantly without sufficiently cold weather (–25 degrees C in the early fall or late spring, or sustained winter temperatures of less than –40 degrees C) to stop it; or unless the population collapses due to a shortage of mature pine. Table 1 also shows that if the beetle continues unabated by cold weather, within five years, about 304 million cubic metres or 64 percent of the mature pine volume in the three TSAs could be affected.

The following table reflects the projected area infested on the total forested land base. As indicated in the table, after about 2007 the total area infested no longer increases significantly as most of the area is already infested to some degree.

Table 2. Projected total area and percent of area of infested stands with any pine [a] on the total forested land base (includes the forested area within and outside of the timber harvesting land base)

| | Includes up to the previous summer's flight[b] | | | | | |
|---|---|---|---|---|---|---|
| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
| TSAs | Total area (thousands of hectares) | | | | | |
| Lakes | 716 | 781 | 826 | 850 | 858 | 861 |
| Prince George | 1 948 | 2 150 | 2 283 | 2 366 | 2 421 | 2 461 |
| Quesnel | 994 | 1 002 | 1 006 | 1 009 | 1 010 | 1 011 |
| Total area | 1943 | 936 | 1118 | 1228 | 1292 | 1336 |
| | Percent of area | | | | | |
| Percent area infested | 76% | 82% | 86% | 88% | 89% | 90% |

Source: Derived from the Provincial Level Projection of the Current Mountain Pine Beetle Outbreak, MoF & CFS (unpublished). May 2004.

(a) Lodgepole pine trees older than 60 years and greater than 12 5 centimeters diameter at breast height.

(b) The area is reported in the year the trees turn red, which is usually the year after the beetle flight and attack.

In previous assessments of the infestation and its impact, various spread rates and impacts have been presented and discussed. Due to the very uncertain nature of predicting the spread, and ultimate extent and impact of the beetles, only after the infestation has subsided will more exact data be available. Therefore the information in this report attempts to improve on previous estimates but nonetheless is subject to some uncertainty.

## Proposed strategies for managing the epidemic

The BC Forest Service and the forest industry have been actively trying to control and manage the mountain pine beetle infestation in the province. In 2000, an Emergency Task Force[3] was formed and released its report, *State of Emergency Declared.*

Since the late 1990s, the management priority in the three TSAs has been to direct harvesting in beetle infested stands so that the remaining stands can continue to contribute to achieving objectives for non-timber values and for future timber supplies.

In addition, provisions under the *Forest Act* allow harvesting to be redirected or temporarily transferred from other management units. The infestation in the Lakes, Prince George and Quesnel TSAs has been recognized as severe enough to warrant this type of redirection. Approved levels of timber harvesting have been redirected from the Bulkley, Morice and Williams Lake TSAs into the three above-mentioned TSAs.

Research information contained in Appendix A - *Forest Stewardship in the Context of Large-scale Salvage Operations: An Interpretation Paper, May 2004* states that to ensure salvage harvesting has the most beneficial effect, harvesting in post-suppression areas should be focused on stands with the most pine trees with the highest mortality. Also, it is important to recognize that salvage operations will be occurring during the term of the outbreak and the beetle's impact will not be static. Therefore not all of the pine that may be killed will be dead when the salvage operations begin.

The BC Forest Service and the forestry industry have been implementing the most aggressive methods possible to slow the spread of the beetle in the three TSAs. However, despite the suppression measures, the epidemic as well as the amount of beetle-killed wood continues to increase. The expansion is due to the sheer size of the beetle population and the recent warmer winters, which have not been severe enough to slow the growth of the beetle population.

On April 2, 2004, the Minister of State for Forestry Operations, the Hon. Roger Harris, released a *Mountain Pine Beetle Action Plan Updated 2004* for managing the impacts of the mountain pine beetle epidemic. In recognition of the key factors contributing to the beetle expansion, the capacity of industry and government to harvest beetle infested trees, and the ability of the market to absorb increased amounts of beetle-damaged timber, the action plan has the following objectives:

- foster new and emerging forest-based activities;
- limit further damage to forests and the environment;
- recover value from the damaged timber; and
- support and encourage economic development and diversity in affected communities.

More specific to the management of the beetle outbreak, the government will:

- continue to redirect harvest from healthy green trees to beetle-damaged wood;
- extend cutting permits to redirect harvest to beetle-infested wood;
- develop new tenure opportunities;
- conduct expedited timber supply reviews in the hardest hit areas;
- investigate ways to transport beetle wood so that it provides the greatest economic benefit, and
- consult with land and resource management planning tables about making provisions in existing land use plans to address the spreading beetle infestation.

A Minister's Community Advisory Group, representing key stakeholder groups from communities, First Nations, forest industry, scientific community, logging contractors, environmental sector and the federal government will provide advice and recommendations on the action plan as it is implemented.

(3) Includes member companies of the Cariboo Lumber Manufacturers' Association and the Northern Forest Products Association

An important consideration in developing management strategies and determining increased harvest levels is the length of time beetle-killed trees will be merchantable, i.e. - the shelf life. The epidemic in the Chilcotin during the 1980s resulted in the continual harvesting of beetle-killed trees, as merchantable sawlogs for over 10 years, and as pulp (chip) fibre for over 15 years after the trees were attacked. However, the current infestation in the three TSAs is different; once the trees have been attacked they are not expected to be merchantable for as long. The northern interior has a wetter climate and sawlog decay is expected to occur faster than in the drier Chilcotin.

There have been many discussions about improving the estimation of shelf life. While beetle-killed trees may remain standing for up to 20 years, their merchantability as sawlogs and recoverable lumber will decline quickly within the first few years as the trees dry and start to check.

Ultimately shelf life will be based on a number of factors and will vary widely based on market prices, available milling technology and biological conditions. While it may be possible to estimate the biological conditions, predicting future market prices and milling technology is difficult. For more information on shelf life, see below.

## Timber supply forecasts

A timber supply computer model was used to project several possible timber supply forecasts for the next 250 years for each timber supply area. For determining allowable annual cuts, most timber supply analyses show a forecast that is called the 'base case forecast'. The base case forecast is based on the best available information and illustrates the effect of current forest management on timber supply.

The following forecasts are based on the analyses completed for the last timber supply review. They show alternative scenarios that examine potential impacts to timber supply given an estimate of the infestation and alternative harvest levels. None of the forecasts are allowable annual cut recommendations, but rather they are one of many sources of information the chief forester will consider when setting the allowable annual cuts. The forecasts presented in this report are for discussion and comparison; due to areas of uncertainty and potential considerations not assessed in the analyses, the allowable annual cut determined by the chief forester may be greater or less than the levels shown in the following forecasts.

As the past winter was not sufficiently cold to reduce the beetle population, it is inevitable that the beetle will continue to spread this summer. Therefore to examine the impact of the current infestation, all the forecasts reflect the volume of wood that is projected to be killed this summer (2004). The forecasts do not account for further spread thereafter, however the chief forester will consider the risk to timber supply from further expansion of the beetle infestation beyond this summer in the three TSAs.

Based on the information discussed above in the *Forest stewardship* section and information gathered from the forest districts, the following key assumptions were applied (exceptions are noted) in the forecasts:

- stand- and landscape-level retention was increased to 20% in moderate- and severe-impacted pine stands. This level of retention reflects current requirements for riparian, wildlife habitat areas, wildlife tree patches, old-growth management areas, as well as increased requirements for legacies (see *Forest stewardship* section).
- maximum percentage disturbance requirements or constraints (e.g., maximum 25 percent of stands permitted below 3 metres in height) were removed for the first 30 years in the moderate- and severe-impacted pine stands. For other stands, the current maximum percentage disturbance was applied.
- harvest priority was focused in stands with a high proportion of pine with moderate and severe levels of attack, while maintaining the current harvest levels in non-pine stands.
- shelf life of beetle-killed trees was a maximum of five years for sawlogs and lumber products; and for increased new salvage opportunities between 6 to 12 years (10 years was modeled) for new types of forest products.
- for stands not harvested, the regeneration delay on average was 10 years from the time of attack. This average reflects some stands regenerating within 2 years (or already regenerating) and some regenerating up to 17 years after attack.
- current visual quality objectives were applied.

### Lakes TSA

The current AAC for the Lakes TSA is 2.962 million cubic metres a year, which includes a previous increase of about 1.5 million cubic metres for the management of the mountain pine beetle infestation.

As shown below in Figure 2, the *current AAC forecast* illustrates the timber supply forecast if the current AAC is maintained for five more years. This level reflects the estimated amount of beetle-killed timber by the end of this summer (see Table 1). For this forecast, the beetle-killed timber is assumed to be available for five years, i.e. - a shelf life that reflects an estimated maximum time that beetle-killed trees may be suitable for sawlogs and lumber.

In the *current AAC forecast*, the current AAC can be maintained for five years before it declines to its pre-uplift level of 1.5 million cubic metres a year for five years. In the longer term, this forecast shows a steady long-term harvest level of 1.7 million cubic metres a year. In this scenario, after five years the beetle-killed timber that remains unsalvaged is about 19 million cubic metres since by this time it will have exceeded the five-year shelf life, or is in younger and lower-level attacked stands or constrained areas such as caribou habitat and visually sensitive areas.

Another forecast, the *2004 beetle forecast*, has all the same assumptions as the *current AAC forecast*, except it reflects a shelf life of 10 years. Given the current amount of beetle-killed timber, existing harvests and current forest cover constraints, it was not possible to achieve a higher forecast for more than five years. In this forecast, all constraints were kept the same as in the previous timber supply review, except the visual quality areas were moved down by one category, for example retention was considered partial retention. In general, this reflects current practice in the Lakes TSA.

In this forecast, the total projected level is 3.17 million cubic metres a year for five years, and then it declines to 1.5 million cubic metres a year. After this, it follows the same pattern as the *current AAC forecast*. In this scenario, after five years the beetle-killed timber that remains unsalvaged is about 18 million cubic metres and is comprised of younger stands, low-level attacked stands or stands in constrained areas such as caribou habitat and visually sensitive areas.

The *2004 beetle forecast* shows that the harvest level could be increased by up to 200,000 cubic metres a year for five years without impacts on future harvest levels beyond those created by the 2004 beetle infestation.

Both of these forecasts do not attempt to project the possible timber supply impacts beyond this summer's beetle flight. It is anticipated that future timber supply analyses will be undertaken to estimate further impacts from the infestation.

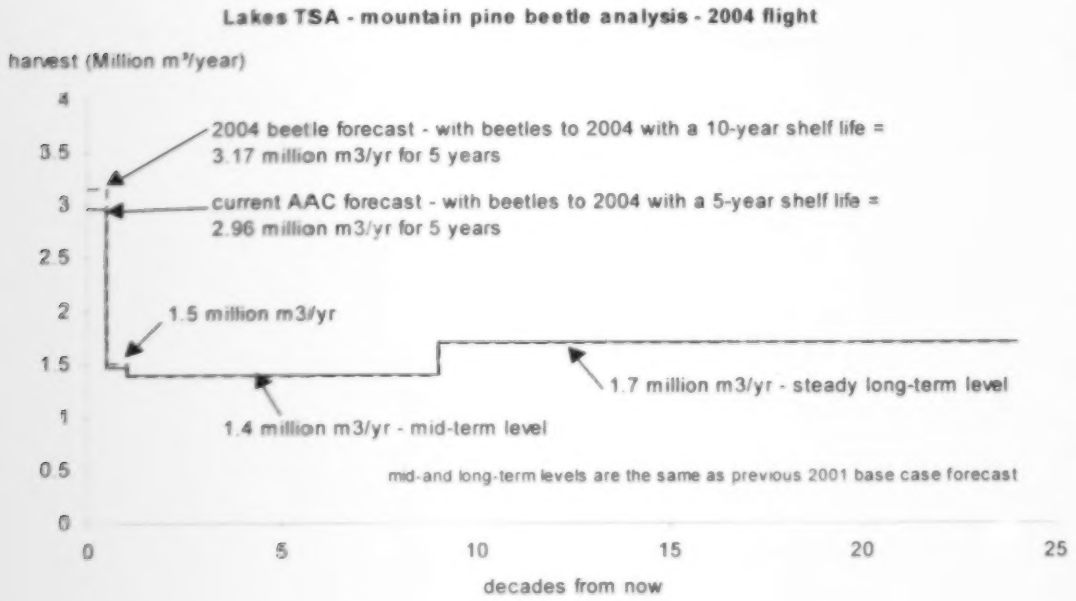
Lakes TSA - mountain pine beetle analysis - 2004 flight
harvest (Million m³/year)
4
3.5
3
2.5
2
1.5
1
0.5
0
2004 beetle forecast - with beetles to 2004 with a 10-year shelf life = 3.17 million m3/yr for 5 years
current AAC forecast - with beetles to 2004 with a 5-year shelf life = 2.96 million m3/yr for 5 years
1.5 million m3/yr
1.7 million m3/yr - steady long-term level
1.4 million m3/yr - mid-term level
mid-and long-term levels are the same as previous 2001 base case forecast
0
5
10
15
20
25
decades from now

Figure 2. Current AAC forecast and 2004 beetle forecast, Lakes TSA, 2004.

### Prince George TSA

The current AAC for the Prince George TSA is 12.244 million cubic metres a year, which includes a previous increase of about 3.0 million cubic metres for the management of the mountain pine beetle infestation.

As shown below in Figure 3, the *current AAC forecast,* as for the Lakes TSA, illustrates the timber supply forecast if the current AAC is maintained for five more years and reflects the estimated amount of beetle-killed timber by the end of this summer (see Table 1). For this forecast, the beetle-killed timber is assumed to be available for five years.

In this forecast, the current AAC could be maintained for five years before it declines by about 3.6 million cubic metres to 8.6 million cubic metres a year for five years, followed by a further decline to the lower mid-term level of 8.2 million cubic metres a year. In the longer term, this forecast shows a steady long-term harvest level of 8.45 million cubic metres a year. In this scenario, after five years the beetle-killed timber that remains unsalvaged is about 65 million cubic metres. This results since by this time it has exceeded the five-year shelf life, or is in younger and lower-level attacked stands, and those with forest cover constraints.

Another forecast, the *2004 beetle forecast,* has all the same assumptions as the *current AAC forecast*, except it reflects a shelf life of 10 years. This reflects the beetle-killed volume that could be harvested over a longer period if the wood could be utilized for other forest products. In this forecast, the total projected level is 14.8 million cubic metres a year for five years. Then it declines by 3.8 million cubic metres to about 11.0 million cubic metres a year for five years.

After 10 years, the beetle-killed timber that remains unsalvaged is about 40 million cubic metres and is comprised of younger and lower-level attacked stands, and those with forest cover constraints.

The *2004 beetle forecast* shows that the harvest level could be increased by up to 2.6 million cubic metres a year for five years without impacts on future harvest levels beyond those created by the 2004 beetle infestation.

Both of these forecasts do not attempt to project the possible timber supply impacts beyond this summer's beetle flight. It is anticipated that future timber supply analyses will be undertaken to estimate further impacts from the infestation.

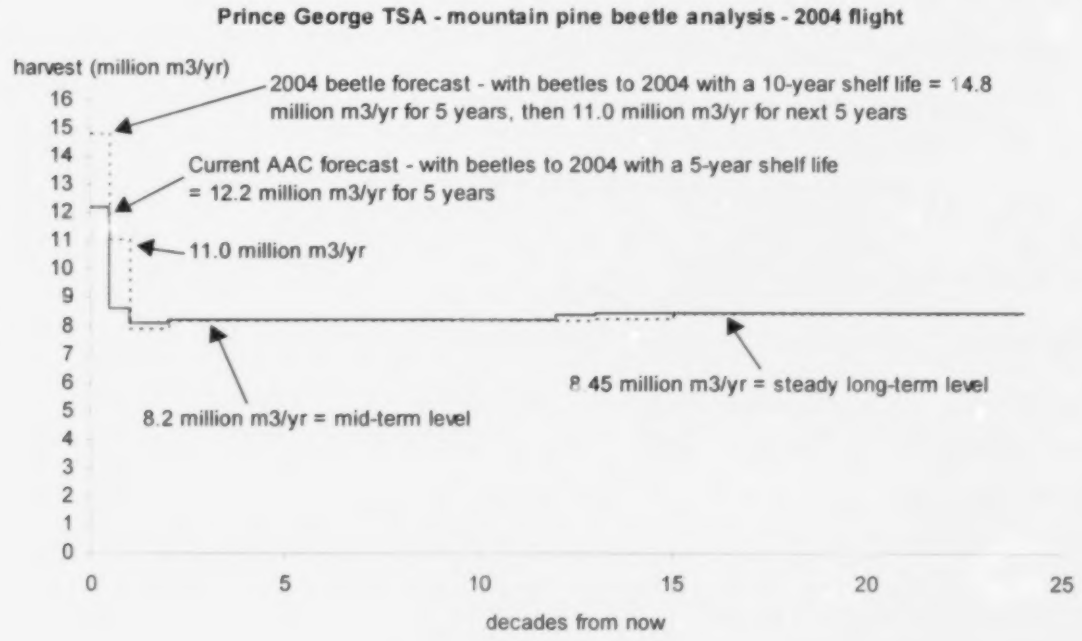


Figure 3. Current AAC forecast and 2004 beetle forecast, Prince George TSA, 2004.

### Quesnel TSA

The current AAC for the Quesnel TSA is 3.248 million cubic metres a year, which includes a previous increase of about 1.0 million cubic metres for the management of the mountain pine beetle infestation.

As shown below in Figure 4, the *current AAC forecast*, as for the Lakes and Prince George TSAs, illustrates the timber supply forecast if the current AAC is maintained for five more years and reflects the estimated amount of beetle-killed timber by the end of this summer (see Table 1). For this forecast, the beetle-killed timber is assumed to be available for five years.

This forecast shows the current AAC could be maintained for five years before it declines by 1.0 million cubic metres (current uplift) to its previous level of 2.34 million cubic metres a year for five years, followed by a further decline to the lower mid-term level of 1.7 million cubic metres a year. In the longer term, this forecast shows a steady long-term harvest level of 2.2 million cubic metres a year. In this scenario, after five years the beetle-killed timber that remains unsalvaged is about 49 million cubic metres. This results since by this time it has exceeded the five-year shelf life, or is in younger and lower-level attacked stands, and those with forest cover constraints.

Another forecast, the *2004 beetle forecast*, has all the same assumptions as the *current AAC forecast*, except it reflects a shelf life of 10 years. This reflects the beetle-killed volume that could be harvested over a longer period if the wood could be utilized for other forest products. In this forecast, the total projected level is 6.0 million cubic metres a year for 10 years, then it declines to about 2.0 million cubic metres a year. After this, it follows a similar pattern as the current AAC forecast, except with a decline in the mid-term. In this scenario, after 10 years the beetle-killed timber that remains unsalvaged is about 18 million cubic metres and is comprised of younger and lower-level attacked stands, and those with forest cover constraints.

The *2004 beetle forecast* shows that the harvest level could be increased by up to 2.75 million cubic metres a year for 10 years without significant impacts on future harvest levels beyond those created by the 2004 beetle infestation.

Both of these forecasts do not attempt to project the possible timber supply impacts beyond this summer's beetle flight. It is anticipated that future timber supply analyses will be undertaken to estimate further impacts from the infestation.

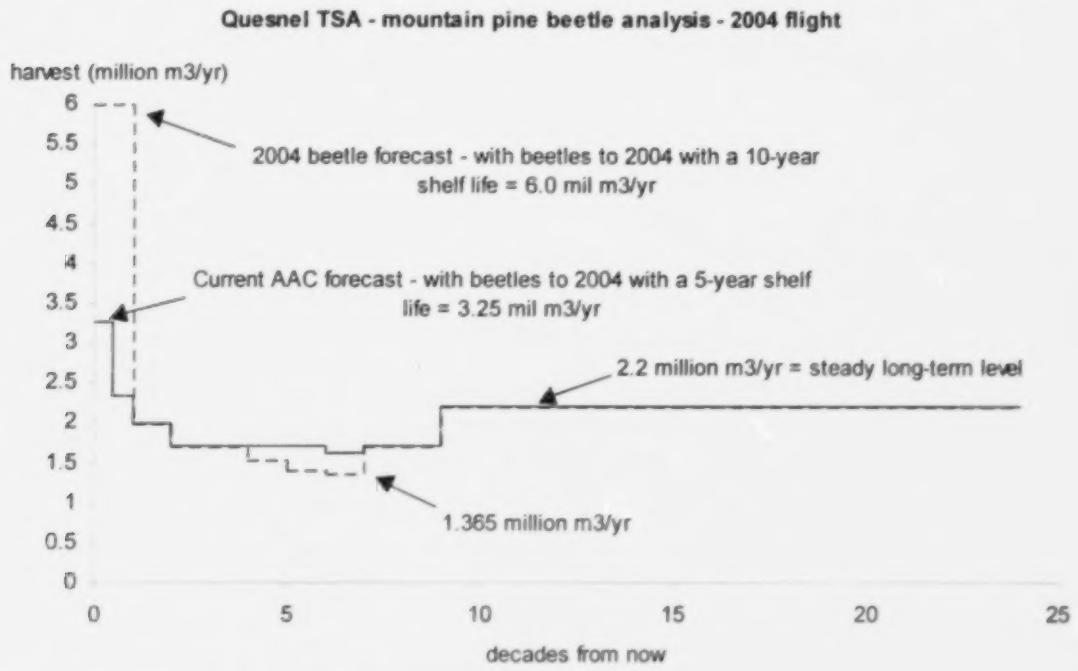


Figure 4. Current AAC forecast and 2004 beetle forecast, Quesnel TSA, 2004.

## Uncertainties

Because forests and the mountain beetle infestations are complex and constantly changing, the chief forester will review uncertainties regarding the timber supply forecasts prior to determining higher harvest levels. The following are some of the critical issues that will be examined:

- merchantability of infested timber (shelf life);
- future spread of the infestation;
- existing (ingress) and future regeneration;
- existing and potential new uses of pine, and the balance of harvesting between infested pine and non-pine stands;
- conservation legacies.

## Summary

The increase in mountain pine beetle populations in conjunction with the presence of a large amount of mature lodgepole pine poses a significant risk to the economic, social, and environmental values in the three TSAs.

After this summer's beetle flight, the amount of beetle-killed timber could be about 160 million cubic metres. The results of the timber supply review, which examined the impact of this beetle-killed volume, suggests that the current AAC of 18.4 million cubic metres a year for the three TSAs could be increased by as much as 5.5 million cubic metres a year for the next five years. These higher levels are possible without significantly impacting timber supplies in the mid to long term beyond the impacts created by the beetle infestation. As noted earlier in this paper, the analysis assumes that harvesting activities at the current AAC will continue to be directed into infested stands, including those already beetle-killed. If this occurs, of the 160 million cubic metres of beetle-killed volume, about 27 million cubic metres could be harvested. The analysis shows that if the harvesting is increased as suggested in the forecasts, there could be a further gain of about 57 million cubic metres.

The increased forecasts can only be maintain for five to 10 years, however they do not account for the spread of the infestation projected during this period.

As noted earlier in this paper, these forecasts are based on harvesting in stands with the highest proportion of pine with moderate to severe levels of attack. The BC Forest Service is proposing management strategies that include both higher harvesting levels, exploring new uses for beetle-killed timber, maintaining the objectives of existing land use plans, as well as continued requirements that harvest activities be focused in the beetle-attacked trees.

## Your input is needed

Establishing the AAC is an important decision that requires well-informed and thoughtful public input. Feedback is welcomed on any aspect of this discussion paper and other issues related to the timber supply in the Lakes, Prince George and Quesnel TSAs. Forest Service staff would be pleased to answer questions or discuss concerns that would help you prepare your response. Please send your comments to the forest district manager at the address below. **Your comments will be accepted until 4:30 p.m. on July 9, 2004.**

You may identify yourself on the response if you wish. If you do, you are reminded that responses will be subject to the *Freedom of Information and Protection of Privacy Act* and may be made public. If the responses are made public, personal identifiers will be removed before the responses are released.

A summary of public comments will be attached to the AAC rationale and will be available from the district offices when the chief forester's AAC determination is announced.

# Lakes, Prince George and Quesnel Timber Supply Reviews

### Discussion Paper Response Form

The *Forest Act* requires the chief forester to consider the following factors to determine the allowable annual cut for timber supply areas and tree farm licence areas in the province, as follows:

- the rate of timber production that can be sustained from the area;
- the short- and long-term implications to the province of alternative rates of tree harvesting from the area;
- the economic and social objectives of the Crown for the area, the general region, and the province, as expressed by the minister of forests, and
- abnormal insect or disease infestations and major salvage programs planned for the area.

Your review is an important part of the timber supply review to ensure the best available information is considered for the Lakes, Prince George and Quesnel timber supply areas.

Please use the space below, or another suitable format to provide your comments regarding any information contained in this discussion paper or other information that you believe should be considered in the determination of the AACs for the Lakes, Prince George and Quesnel timber supply areas.

**Your comments will be accepted until 4:30 p.m. on July 9, 2004.**

Continued on next page.

Add an extra sheet if you need more space.

Name (optional):

Address (optional):

Mail or fax your comments to:

**Mailing address:**
Provincial Chief Forester
C/O Forest Analysis Branch, Ministry of Forests
Box 9512, Stn Prov Govt
Victoria, BC V8W 9C3

**Street location:**
Forest Analysis Branch
Ministry of Forests
1-1520 Blanshard Street
Victoria, BC

**Fax**: 250-953-3838

**More information is available on the following websites.**

For more information about mountain pine beetles, please visit this website:
http://www.for.gov.bc.ca/hfp/mountain_pine_beetle/

For more information about timber supply analyses and allowable annual cuts, please visit this website:
http://www.for.gov.bc.ca/hts/

For more information about the new mountain pine beetle research report, please visit this website:
http://www.for.gov.bc.ca/hre/bcmpb

# Appendix A

## Forest Stewardship in the Context of Large-Scale Salvage Operations:

## An Interpretation Paper

Prepared for Larry Pedersen, Chief Forester
for consideration during Allowable Annual Cut determinations
for Lakes, Prince George and Quesnel TSAs

Prepared by the Forest Science Program of the BC Forest Service

May 31, 2004

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## Acknowledgements

This paper is the result of a collective effort of many staff within the Forest Science Program of the British Columbia Forest Service.

We would like to thank Dr. Fred Bunnell of the Centre for Applied Conservation Biology at the University of British Columbia and Melanie Boyce of the Forest Analysis Branch of the BC Forest Service for insightful and constructive comments on earlier drafts.

## Summary

All indications are that the current mountain pine beetle outbreak will have a significant impact on a large proportion of the pine forests in B.C. (Eng *et al* 2004). It is neither desirable nor possible to harvest all of the impacted pine forests. However, any further increases beyond current harvest levels must carefully consider all forest values. This document provides recommendations to the chief forester about methods to conserve forest values, to the extent possible, while mitigating timber losses.

Poorly planned and/or poorly executed large-scale salvage operations have the potential to cause significant negative effects on a variety of forest values (Lindenmayer *et al* 2004):

- salvage harvesting activities can undermine many of the ecosystem benefits of major disturbances;
- removal of large quantities of biological legacies can have negative impacts on taxa that require, or benefit from, those legacies;
- salvage logging can impair ecosystem recovery; and
- some taxa may be maladapted to the interactive effects of two disturbance events in rapid succession.

There are additional, specific and significant concerns about the potential for large-scale salvage operations to affect hydrological regimes at various scales (Foster et al. 1997).

Some contend that the magnitude of the current outbreak is at least partially the result of human influence on the pine forests in B.C., principally due to forest fire suppression (Stadt 2002, Taylor and Carroll 2003). If that is the case, it could be argued that it is incumbent on forest managers to attempt to mitigate the effects of the outbreak through appropriate management that includes well-planned and properly executed large-scale salvage operations. By diverting harvest from green to dead trees, the impact on forest values could be partially mitigated.

Others contend that the outbreak is a "natural" event (Hughes and Drever 2001). If that is the case then the large areas of partially dead forests created by the outbreak are within the 'range of natural variability' (Swanson et al. 1994, Wong and Iverson 2004). Regardless of the cause, large-scale salvage operations will result in conditions that differ from those that would be created by the outbreak alone and the combined effects will be outside the range of natural variability. In any case it is clear that society does not support managing for the entire range of natural variability, for example 1000 year floods, meteor strikes, etc. At the same time some management response to the outbreak is appropriate and likely requires a large-scale response.

The following is a summary of the key recommendations regarding forest stewardship. These recommendations are intended to inform the determination of the allowable annual cuts for the Lakes, Prince George and Quesnel timber supply areas:

- At the landscape level (10,000 to 100,000 hectares) at the very least, leave what was originally planned under existing landscape level plans (regional land use plans, land and resource management plans, etc). This includes provisions for old-growth management areas since areas with considerable dead pine are still of value to biodiversity and should be retained if no suitable replacement old-growth areas are available. Mixed species stands should be used wherever possible to contribute to the mature requirement; however, stands with some dead pine still provide biodiversity values.
- As a general rule, there should be little, to no salvage harvesting in the non–contributing land base (areas outside of the timber harvesting land base as assumed in the last timber supply analysis for the three TSAs).
- There should be no changes to the provisions made for riparian management areas (RMAs) and riparian reserve zones (RRZs). It will likely be desirable to remove some of the dead pine component from RMAs rather than other species if they occur. It will be important to carefully monitor the management of RMAs and RRZs over time because of the potential for excessive inputs of large woody debris into streams and the potential for increases in peak flow regimes may cause increased erosion and transportation of sediment and woody debris. As well, there should be no changes to the management of wildlife tree patches, wildlife habitat areas and other fine filter measures.
- Legacies of coarse woody debris should be left throughout the blocks. Higher levels of retention than those recommended under the *Forest and Range Practices Act* for harvesting in healthy forests will be appropriate because, under natural conditions, most beetle-killed stands would have very high levels of coarse woody debris.

- The creation of large openings (> 1,000 hectares) will be appropriate, provided that they are designed to respect existing land use planning objectives. In addition the legacies of unharvested areas within the openings should increase in proportion to the increasing size of the opening (up to 25% in the case of 1,000 hectare openings).
- The spatial distribution of legacies, including wildlife tree patches can be as important as the relative amounts remaining. Clearly wind firmness will become a significant issue but the legacies of live and dead trees that will be left will be valuable whether or not standing. It is important to ensure the legacies are representative of the "matrix" forests, for example reserve wet spruce or aspen forests if not able to maintain any mature pine forests.

Other related recommendations include:

- A large number of temporary access structures (roads, trails, landings, etc.) will be created over a very short period of time. Development of those structures should adhere to all existing regulations and they should be decommissioned as soon as possible after operations have ceased. Increased access resulting from improvements to permanent roads must be carefully managed to prevent negative effects on wildlife populations.
- To reduce adverse effects on peak flows and soil erosion, no harvesting should occur on unstable terrain, harvested area should be promptly and fully restocked, and all potentially 'compromising' access structures should be rehabilitated.
- Where ecologically acceptable, plant species other than pine to lessen future problems with mountain pine beetle outbreaks.
- Conducting salvage operations based on the premise of reducing fire risk is not recommended except in the wildland-urban interface.
- Monitoring programs should recognize the requirement for implementation monitoring (did we do what we said we were going to do?) and effectiveness monitoring (did our actions have the desired effect?). A well-planned monitoring program must be developed to include both of these aspects.

## Introduction and Context

British Columbia is currently in the midst of the largest recorded mountain pine beetle outbreak in North America (Ministry of Forests 2004). In 2003, the outbreak was already significantly larger than the last major outbreak in the 1980s, which occurred on the Chilcotin Plateau (c.f. Wood and Unger 1996 and Ministry of Forests 2003).

In response to the potential loss of timber volume, the Ministry of Forests is considering increasing the allowable annual cut in three timber supply areas (TSAs): Lakes, Prince George and Quesnel TSAs. The proposed increases will primarily be directed at salvaging, rather than suppressing the spread of the beetle outbreak.

All indications are that the outbreak will have a significant impact on a large proportion of the pine forests in B.C. (Eng *et al.* 2004). It will not be possible, nor desirable to harvest all impacted pine forests, however, any further increases beyond current levels must carefully consider stewardship values. This document has been developed to provide recommendations about methods to conserve forest values, to the extent possible, while mitigating timber losses.

Poorly planned and poorly executed large-scale salvage operations have the potential to cause significant negative effects on a variety of forest values (Lindenmayer *et al* 2004):

- salvage harvesting activities can undermine many of the ecosystem benefits of major disturbances;
- removal of large quantities of biological legacies can have negative impacts on taxa that require or benefit from those legacies;
- salvage logging can impair ecosystem recovery; and
- some taxa may be maladapted to the interactive effects of two disturbance events in rapid succession.

There are additional, specific and significant concerns about the potential for large-scale salvage operations to affect hydrological regimes at various scales (Foster et al. 1997).

Some contend that the magnitude of the current outbreak is at least partially the result of human influence on the pine forests of British Columbia, principally due to forest fire suppression (Stadt 2002, Taylor and Carroll 2003). If that is the case, it could be argued that it is incumbent on forest managers to attempt to mitigate the effects of the outbreak through appropriate management that includes well-planned and properly executed large-scale salvage operations. By diverting harvest from green wood to salvage of dead trees the impact on forest values could be partially mitigated.

Others contend that the outbreak is a "natural" event (Hughes and Drever 2001). If that is the case then the large areas of partially dead forests created by the outbreak are within the so-called "range of natural variability" (Swanson *et al.* 1994, Wong and Iverson 2004). Regardless of the cause, large-scale salvage operations will result in conditions that differ from those that would be created by the outbreak alone and the combined effects will be outside the range of natural variability. In any case it is clear that society does not support managing for the entire range of natural variability (e.g. 1,000-year floods, meteor strikes, etc.). At the same time some management response to the outbreak is appropriate and likely requires a large-scale response.

## Landscape and stand level planning

There are two key uncertainties regarding landscape and stand level planning, which must be considered in much of the following discussion:

- It is unclear when the outbreak will subside and what levels of live pine will be left on the landscape when it does.
- It is unclear exactly how the forest industry will approach the issue of large-scale salvage. This is particularly true with respect to the possible "new" uses of the dead pine that are being considered under the "requests for expression of interest" process.

### Landscape level objectives

Planning large-scale salvage operations should not (Lindenmayer *et al.* 2004) and need not (Hughes and Drever 2001) be done in haste. The following discussion is predicated on the assumption that sufficient time and resources will be devoted to planning any large-scale salvage operation.

The fundamental question, at the landscape level (10 – 100,000 hectares), is what dead wood should be salvaged and what should be left behind? The simple answer to this question, elaborated in some detail below,

is: at the very least leave what was originally planning under existing landscape level plans (regional land use plans, land and resource management plans, etc). There are two reasons for this recommendation.

First, targets set for landscape level objectives are the result of agreements among environmental, economic and social concerns. Therefore, the targets set for environmental concerns may have been established based on trade-offs. Based on the existing agreements, it seems reasonable that, given the uncertainties and potential risks of salvage operations, the agreed-to parameters should not be reduced from those originally set for all the forest values prior to the outbreak.

Secondly, over the course of the outbreak in the province, there is estimated to be approximately 200 million $m^3$ of salvageable pine on the landscape in any given year (Eng *et al.* 2004). However, the total AAC for the interior (all units except the coast region) of the province is 56 million $m^3$ (http://www.for.gov.bc.ca/hts/aac.htm). Given the current harvest levels are well below that required to salvage all of the existing dead pine and that even with new markets not all the dead pine could possibly be utilized, substantial amounts of dead pine will be left on the landscape. Therefore increased salvage activities should be designed similar to originally planned activities (Stadt 2002).

As discussed below, it will not be possible to completely separate objectives or planning for landscape and stand level retention during planning for large-scale harvesting operations. There will be appropriate local variance in recommendations at both levels. However, we expect that most proposals to utilize the dead wood may project marginal economic viability. As a result there may be pressure to reduce the objectives and constraints designed to protect future forest values. Each proposal to reduce constraints should be evaluated on its own merits.

If the recommended approaches contained in this paper are adopted then the "footprint" caused by the combined green tree and salvage harvesting should not significantly exceed that which would have occurred in the absence of the outbreak – the "footprint" size would simply be reached sooner. Nonetheless, there will be a significant concern about the environmental impacts of the rapid increase in the rate of harvesting. That concern can be partially addressed by ensuring there is sufficient amount of unharvested "legacies" remaining.

In addition to increasing the amount of harvesting in the current operating areas (the timber harvesting land base), the infestation may provide opportunities to extend harvesting into some of the non-contributing landbase. This would only be appropriate where it could be clearly demonstrated that the harvesting will maintain or enhance non-timber objectives (e.g. ecosystem restoration and wildlife habitat improvement in parks). However, as a general rule it is recommended that no salvage harvesting should occur in the productive non-contributing landbase.

For the three TSAs where increased salvage harvesting is under consideration, these types of areas include:

- Environmentally sensitive areas (particularly steep and/or unstable slopes);
- Class A lake shore;
- Inoperable areas;
- Unmerchantable forest types;
- Cultural heritage areas; and
- Area-specific netdowns, such as riparian, wildlife habitat, wildlife tree, and old growth management areas.

This concurs with Stadt (2002) who concluded that the outbreak does not fundamentally change things with respect to principles of Landscape Unit Planning. More specifically, the following recommendations should be implemented with regarding to landscape level planning:

- Consider dividing the old growth management areas (OGMAs): "budget" into spruce-dominated areas and pine-dominated areas. The pine-dominated areas would become "recruitment" areas or "wild young forests". OGMAs with considerable dead pine are still of value to biodiversity and should be retained if no suitable replacement OGMAs are available. It is possible that the outbreak is a harbinger of a future where climate change will result in much higher levels of mountain pine beetle infestation than we have experienced in the past. If that is the case then it may be useful to select "recruitment" areas that have advanced regeneration of species other than pine (e.g., spruce and/or balsam fir).
- It is desirable, although possibly difficult, to maintain mature plus old targets, in jurisdictions that have such targets (e.g. CCLUP Quesnel Forest District). Mixed species stands should be used wherever possible to contribute to the mature requirement; however, stands with some dead pine still provide biodiversity values.

- There should be no changes to the provisions made for riparian management areas (RMAs) and riparian reserve zones (RRZs). It will likely be desirable to remove some of the dead pine component from RMAs, rather than other species if they occur. It will certainly be important to monitor carefully the management of RMAs and RRZs over time because of potential for excessive inputs of large woody debris and possible increases in peak flow regimes causing increased erosion and transport of sediment and wood (e.g., McLennan 2003).
- Recommended changes in the management of wildlife tree patches are discussed below in the section on stand level retention. Clearly wind firmness will become a more significant issue but the legacies of live and dead trees that will be left will be valuable whether or not standing.
- There should be no changes to the management of wildlife habitat areas and other fine filter issues.
- In Quesnel where ungulate winter ranges are, or should be, Douglas-fir dominated, selective salvage of dead pine should be allowed provided there is little or no impact on the Douglas-fir component. In the Lakes and Prince George TSAs, any decisions about ungulate winter ranges should be made on a site-specific basis but, in general, no change should be made to their management.
- Harvesting in caribou habitat areas should be prohibited in those areas removed from the timber harvesting land base (primarily in the Itcha – Ilgachuz area) and only allowed in the "modified" zones to the limits already agreed to (Youds et al. 2002). There is considerable speculation about the impacts of both beetle attack and forest harvesting on the quality of caribou habitat. It is possible that the beetle damage and any subsequent harvesting could encourage the growth of terrestrial lichens used as a food source by caribou because of reduced crown closure. Conversely, it is possible that canopy removal may result in deeper snow packs that would restrict feeding opportunities. A precautionary approach would dictate that no harvesting in caribou habitat areas until this fundamental difference in the possible outcomes is resolved.

## Stand level objectives

Some salvaging is already underway, however increased salvage levels will be initiated soon and will continue for many years. These operations will be occurring during the term of the outbreak and the beetle's impact will not be static. Therefore not all of the pine that may be killed will be dead when the salvage operations begin. Table 1 provides a matrix of stand characteristics to set priorities for salvage among stands. This matrix provides a "sliding" scale of the possible outcome (percent of volume that is pine) and the current state (percent of pine volume killed).

*Table 1. Priority for salvage based on stand characteristics and level of beetle kill (modified from McLennan, 2003).*

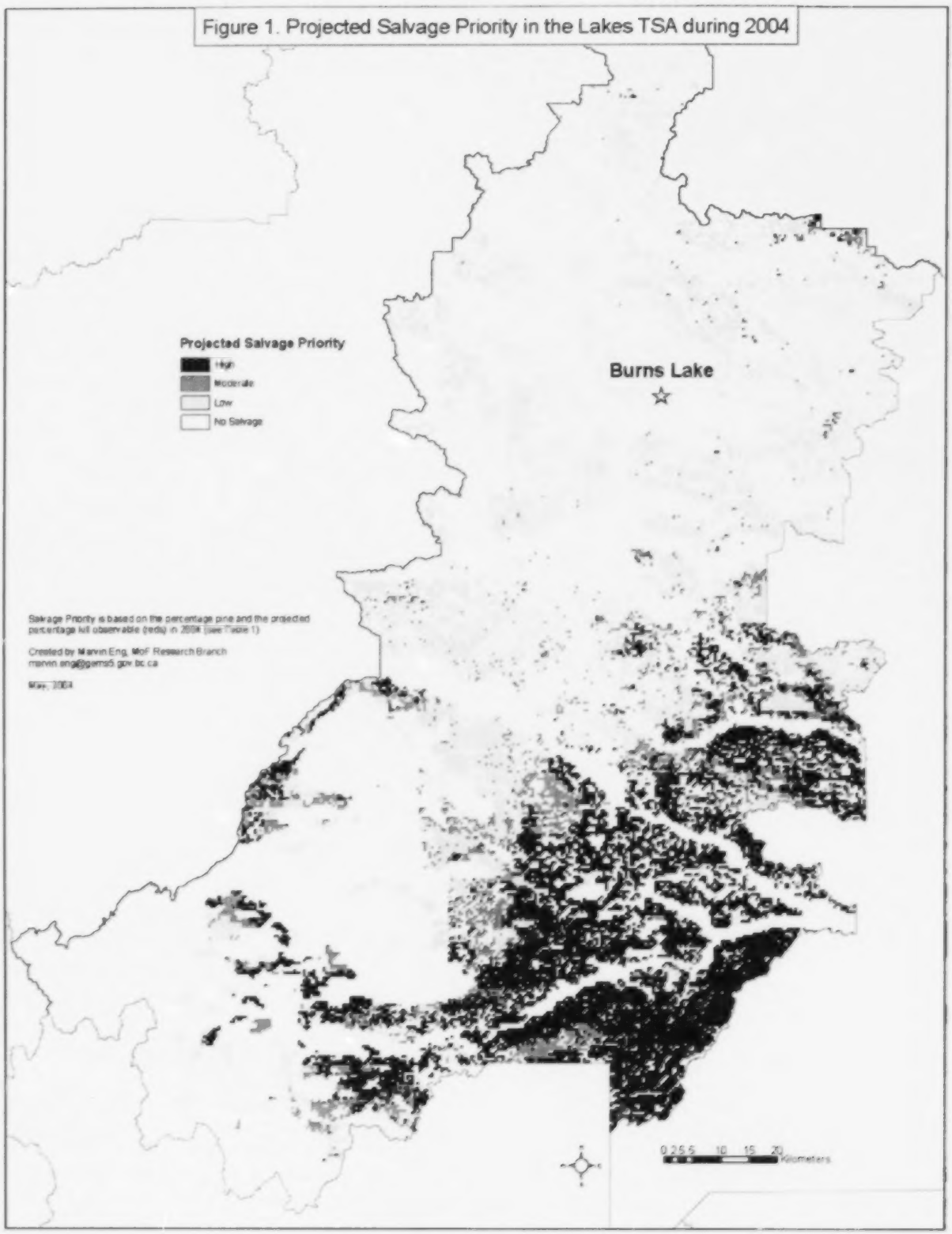
| | Percent of Pine Volume Killed | | | |
|---|---|---|---|---|
| Percent of Stand Volume that is Pine | < 30 % | 30 – 50 % | 51 – 70 % | > 70 % |
| < 30 % | No | No | No | No |
| 30 – 50 % | Low | Low | Low | Low |
| 51 – 70 % | Low | Moderate | Moderate | High |
| > 70 % | Low | Moderate | High | High |

Figures 1, 2, and 3 show the projected distribution of High, Moderate, Low and No priority salvage areas for 2004 in the Lakes TSA, the southwest portion of the Prince George TSA and Quesnel TSA, respectively.

An additional consideration should be that stands that are well-stocked with pole-sized regeneration of species other than pine should have a low priority for salvage because these stands will develop old growth features and commercial value faster than ones without a non-pine understory. The location of stands of this type may be predicted by relationships with the distance from non-pine seed sources.

Legacies of coarse woody debris (CWD) should be left throughout the blocks. It is recommended that, while the *Forest and Range Practices Act* default results for CWD may be suitable for harvesting in "healthy" forests, they are far too low for salvage operations. Much higher levels of retention would be appropriate because, under natural condition, most beetle killed stands would have very high levels of coarse woody debris. The targets for coarse woody debris retention should be closer to the recommended waste billing benchmarks, which vary by site: 9 $m^3$ on dry sites, 15 $m^3$ on mesic sites, and 25 $m^3$ on wet sites.

Figure 1. Projected Salvage Priority in the Lakes TSA during 2004



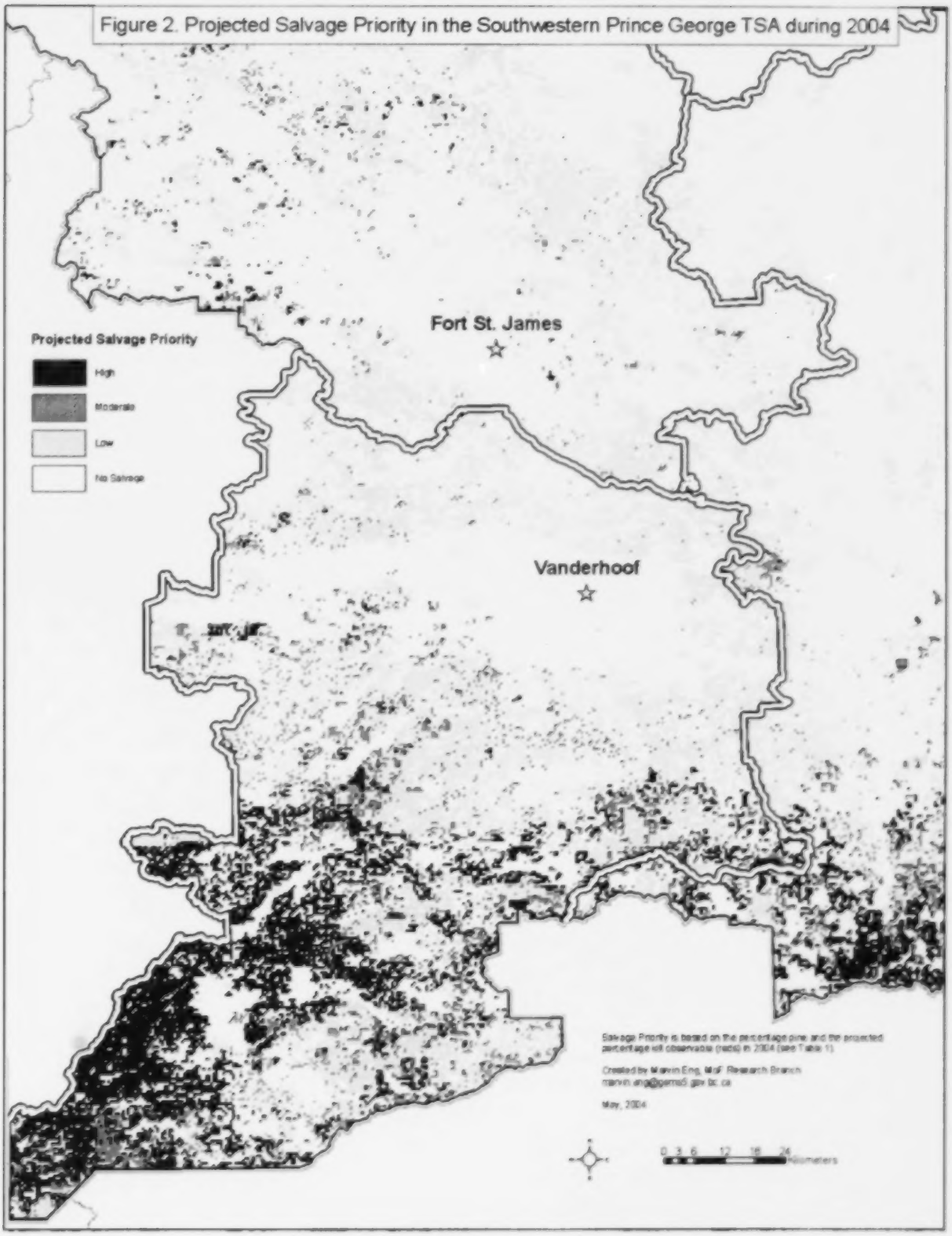


Figure 2. Projected Salvage Priority in the Southwestern Prince George TSA during 2004
Fort St. James
Vanderhoof
Projected Salvage Priority
High
Moderate
Low
No Salvage
Salvage Priority is based on the percentage pine and the projected percentage still observable (reds) in 2004 (see Table 1).
Created by Marvin Eng, MoF Research Branch
marvin.eng@gems5.gov.bc.ca
May, 2004
0 3 6 12 18 24
Kilometers

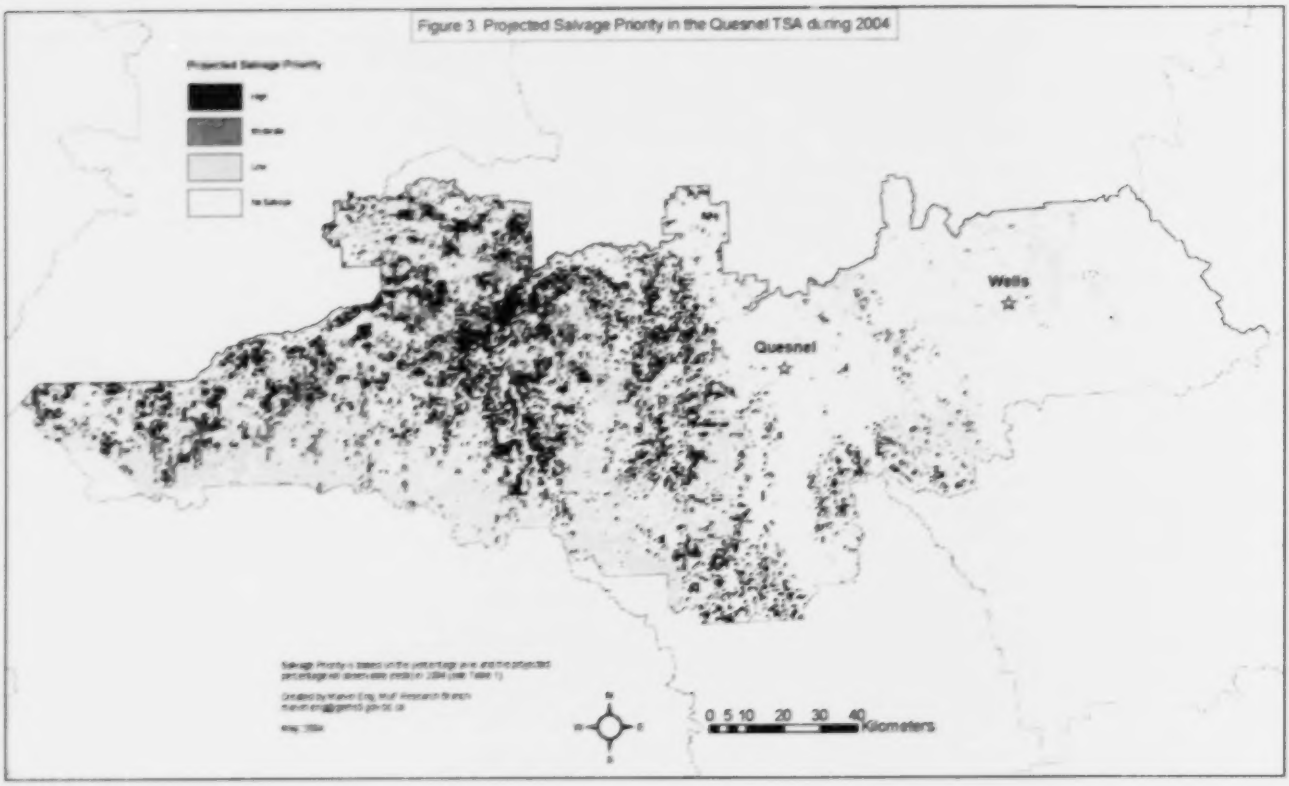



Figure 3. Projected Salvage Priority in the Quesnel TSA during 2004

Prior to the outbreak, the forest industry relied primarily on relatively small (< 60 hectare) openings that have created a mosaic of more-or-less uniform sized patches of young forest in an old matrix (that is now declining in size and in continuity). As a result of the mountain pine beetle outbreak, there is now a significant opportunity to create some large openings. The creation of large openings (> 1,000 ha) are within the range of natural disturbance levels, provided they are designed to respect existing land use planning objectives and that the legacies that are left increase in proportion to the increasing size of the opening (Table 2). Although there is provision for small blocks this should not encourage the development of small blocks in the context of large-scale salvage operations.

*Table 2. Proposed proportion of un-harvested legacies (retention levels) left based on opening size.*

| Opening Size | Percent of Opening un-harvested |
|---|---|
| <50 ha | 10% |
| 50 – 250 ha | 10 – 15% |
| 250 – 1000 ha | 15 – 25 % |
| > 1000 ha | > 25 % |

There are several very important considerations and caveats related to the recommendations in Table 2:

- The spatial distribution of the legacies can be as important as the relative amounts remaining. The amount of live forest in the "matrix" is going to be significantly reduced. It is important to ensure the legacies are representative of the "matrix" forests (i.e. not to over emphasize the reservation of wet spruce forests or aspen forests at the risk of not maintaining any mature pine forests).
- Recommendations about stand level retention must be implemented with a full understanding of the implications at the landscape level. Separate landscape and stand level planning effects can not be specified as if they were independent. It is possible that stand level management that "aggressively" attempts to ameliorate the impact of the outbreak in one area could result in a relaxation of landscape level requirements in some other area. Moreover, at present little is known about how difficult or easy it will be to maintain these targets under large-scale salvage operations.
- It should also be noted that the above recommended "retention" levels are proposed for one rotation. Once the harvested matrix has matured, new planning may indicate the retained areas can or should be harvested.

Innovative or non-traditional (non-clearcut) silvicultural systems should be encouraged, where appropriate, to maintain some biological legacies. Some of these are already be used in harvesting areas with low levels of attack or low volume in pine.

## Other issues

### Access management

A large number of temporary access structures will be created over a very short period of time. Development of those structures should adhere to all existing regulations and they should be decommissioned as soon as possible after operations have ceased.

The network of permanent access structures will require expansion and upgrading. There is a significant public safety issue regarding improvements to public roads and bridges along with increased industrial traffic. More importantly, from a conservation perspective, the public will gain access to previously inaccessible or poorly accessed areas. They will develop an expectation for continued levels of access. Increased human access can be a very detrimental influence on wildlife habitat (Saunders *et al.* 1991, Forman 2003). Access management plans should be developed along with salvage operations to mitigate this potential damage.

### Hydrologic stability and open slope failure

There is some concern that the rate of harvest in salvage operations, combined with previous harvesting and sanitation operations, may adversely affect peak flow characteristics and unacceptably increase erosion, sediment delivery and bedload movement. Additional concerns have been expressed about open slope failure as the mature root mat decomposes over the next 10 to 20 years. These issues are a real concern in spite of the generally more benign terrain and precipitation characteristics of the forests in question. The main issue results from proposed harvest rates that are well beyond the last data point on the graph of harvest vs. hydrology response. To help minimize these concerns, the following recommendations should be considered:

- ensure that harvested areas are fully restocked and that all potentially "compromising" access structures are rehabilitated,
- ensure that no harvesting occurs in unstable terrain and develop engineering solutions where required to maintain slope stability.

### Future susceptibility to mountain pine beetle outbreaks

Clear cut harvesting over very large areas with very high levels of utilization will result in future forests that are highly susceptible to mountain pine beetle outbreaks. Large, "clean" clear cuts are not recommended. Where ecologically acceptable, plant species other than pine to lessen future problems.

### Interactions with fire

Increased risk of fire in mountain pine beetle affected stands has been postulated by many but evidence in the literature is equivocal (e.g. Turner *et al.* 1999). Conducting salvage operations based on the premise of reducing fire risk is not recommended except in the wildland-urban interface.

### Interactions with other planning processes

Landscape unit planning, Innovative Forestry Practices Agreement studies, implementation of LRMPs and Cariboo-Chilcotin LU plans (CCLUP) are ongoing. In the case of the CCLUP, the Biodiversity Committee is attempting to address the unfolding mountain pine beetle issue. All recommendations provided here need to be incorporated into those planning efforts. Nonetheless, it could be argued that, for the 3 TSAs (Lakes, Prince George and Quesnel), the current mountain pine beetle outbreak will have such an enormous impact that the outbreak should be the primary planning consideration for the immediate future. Therefore, the process should prioritize salvage operations first and then determine how much the non-pine stands can contribute to meeting the goals of the existing land-use planning objectives.

## Monitoring

The current mountain pine beetle outbreak is clearly an extraordinary event and therefore it will require a significant commitment to monitoring the long-term effects. It is imperative that monitoring occurs not only to better manage future outbreaks but also to better manage the results of the current outbreak.
Monitoring programs should recognize the requirement for implementation monitoring (did we do what we said we were going to do?) and effectiveness monitoring (did our actions have the desired effect?). A well-planned monitoring program must be developed to include both of these aspects.

Implementation monitoring will principally be about determining whether or not forest practices are following the principles outlined in the recommendations contained in this paper. Effectiveness monitoring should concentrate on three topics:

- Forest growth and dynamics; primarily regeneration of pine in salvaged and not salvaged areas and release of the non-pine component of the stands affected by mountain pine beetle.
- Hydrological and riparian ecosystem changes; primarily responses of watersheds (discharge, temperature, nutrients, and fluvial geomorphology).
- Ecosystem responses as evidenced by changes in biodiversity (primarily vertebrate populations but also lichens and invertebrates) and ecosystem processes (primarily nutrient cycling and soil fertility).

Another final recommendation is that we should not miss the opportunity to build a mountain pine beetle data legacy to aid in the management of future outbreaks. This should include monitoring through time the:

- location and intensity (pine killed) of the infestation, and
- forest management responses of suppression attempts and salvage.

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